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THE HISTORY OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

II

MEETINGS

The Association of American Geologists and Naturalists held its closing session in the Library Room of the Academy of Natural Sciences of Philadelphia, at 10 a. m., September 28, 1848. The chairman was William B. Rogers, acting in place of President Amos Binney, deceased. The proposed constitution for the larger society was adopted. At four o'clock, in the College Hall of the University of Pennsylvania, the president-elect of the new organization, William C. Redfield, was introduced and the American Association for the Advancement of Science was formally declared.

The Proceedings of the Association, Volume I, tells the story of that first meeting; and a good account is also given in the *American Journal of Science* (6: 393–401).

The first day of the meeting was wholly in general session, with the presentation of papers. On the second day the association divided into the two sections provided for by the new rules. Louis Agassiz presided over the natural science section, and Joseph Henry over the physical science. Agassiz is credited with 11 papers at this meeting. A total of 56 titles, covering a wide range of interest, are listed in the *American Journal* (6: 393). At the second meeting, in Cambridge, 107 papers were presented.

Evidently there was interest and enthusiasm in the new and broader association, for in 1850 two meetings were held, in March at Charleston, S. C., and at New Haven in August. Two meetings were also held in 1851, at Cincinnati in May and at Albany in August. But no meeting was held in 1852, the one planned for Cleveland being deferred on account of the prevalence of cholera (7: 273). The number of the meetings and the corresponding number of the volumes of Proceedings do not agree with the calendar years.

In 1860 the civil war had begun, and the meeting proposed for Nashville in 1861 was postponed "for one year" (14: VIII), and meetings were not resumed until the end of the war. The first two meetings following the war, in Buffalo, 1866, and Burlington, Vermont, 1867, had the smallest attendance in the history of the association, 79 at the former meeting and 73 at

the latter. One cause of the small size of these meetings was the absence of members from the southern states. Not until 1877, at the Nashville meeting, did the association again become truly national.

The record of places of meeting, dates, registration and total membership is given complete for 66 meetings, to 1914, in the volume of summarized proceedings of 1915. The volume of 1921 omits this tabulation.

As early as the third meeting, March, 1850, the association went south to Charleston, and southwest to Cincinnati, in May, 1851. Canada was visited in 1857, at Montreal, but a second Canadian meeting was not held until 1889, at Toronto. In 1872 the association ventured as far west as Dubuque. The first southern meetings following the unfortunate interruption by the civil war, not only of the meetings but of the truly national character of the society, was in 1877, at Nashville, and in 1878 at St. Louis.

Not until 1887 did the association venture to invade the arena of the bulls and bears in New York City, although an invitation had been extended by Fernando Wood, the mayor, in 1857 (11: 171, 181). Plans were laid for a meeting in San Francisco in 1872, but they failed, and the meeting that year was in Dubuque. Not until 1901 was a meeting held west of the Mississippi valley, and then in Denver. Since then two summer meetings have been held in California, at San Francisco, 1915, and Los Angeles, 1923. The organization of the Pacific and the Southwestern Divisions has now removed the necessity of frequent far-west meetings of the entire association.

It is surprising that Philadelphia, the birthplace of the association, 1848, and of its grandparent society, 1840, was not paid a visit until 1884, an interval of 36 years. An invitation was given the association for 1876, an interval of 28 years. We may not suppose that Philadelphia was ashamed of its illustrious product. Probably the city was preoccupied with its commercial affairs and its local politics, and no sufficient hint was received that it should invite its progeny to a scientific family reunion. To nearly the present time the meetings of the association were held on invitation from the cities. Rarely has it been necessary to seek such invitation. On the contrary, the invitations have sometimes been so multiplied and so urgent that the permanent secretary and the council have had to be tactful and diplomatic.

The formalities of the opening sessions have always, and properly, emphasized the addresses of welcome on behalf of the entertaining cities. Many of these are printed in full in the proceedings. A very flattering compilation of the industries, excellencies and beauties of American cities could be gathered from the welcoming addresses.

As early as 1854 we find references to favors by the transportation companies, and in 1860 the form of railway certificate was published (14: 252). In 1856 the Atlantic steamships offered liberal concessions, which have been repeated in later years.

A feature of the meetings, with both social and scientific aspects, has been the excursions, local during the sessions, and longer following adjournment. Reduced rates, and often free transportation, have been given for extended trips. Following are a few examples: 1871, from Indianapolis to Kentucky and Mammoth Cave; 1872, from Dubuque across Iowa; 1877, from Nashville to Texas; 1878, from St. Louis to Colorado; 1889, from Boston to the White Mountains.

In 1902 the city of Pittsburgh raised $9,000 for the expense of excursions. The vast territory of the United States and Canada, with the great variety of scenic and geologic features and of resources, has made the extended excursions very attractive.

The early volumes of Proceedings are deficient in the incidental matters and social events of the meetings, which would interest us to-day. Fuller accounts begin with the reports of the general secretary, following the change in organization of 1874.

The dignified proceedings do not record the spontaneous events, peculiar incidents, accidents and disputes, which must sometimes have enlivened the meetings. For example, what was the trouble at the 11th meeting, 1857, at Montreal, with James Hall's presidential address? In volume 11, page 169, occurs the following resolution: "That a committee be appointed to wait upon the retiring president of the association and invite him to deliver his address at some proper time and place and under more favorable circumstances than those which existed at the social meeting of August 13." The record states that the address was given on Tuesday p. m., August 18. The meeting began Wednesday, August 12.

In the record of the Albany meeting, 1851, is a resolution which piques our curiosity: "Res., that considering the circumstances in which they were placed, the members of this association do entirely approve of the action of the standing committee of this year" (6: 402).

We are not informed of the occasion for the appointment of Joseph Henry as a special committee of one on "scientific ethics" (4: 391). Unfortunately for our scientific morals the subject was not elucidated by any report.

In 1883 (7: 274) twelve men were named to report on special topics, and the list was carried through four volumes. The absence of any mention of such reports suggests that men were just as busy, or just as dilatory, then as now. And it is very unfortunate that such reports were not prepared and published.

Similar reports were made to the British association during the earlier years, and were of the utmost value, not only in summarizing the knowledge to that time but as suggesting lines of desirable research.

Many volumes contain the long prayers which were delivered at the opening sessions. At Buffalo, in 1886, Bishop Coxe was scientific, and gave a preliminary description of his invocation, which had been compiled from the writings of an Alexandrian Jew of two centuries B. C. (35: 363). The sentimental general secretary adds: "On pronouncing the Lord's Prayer a quite general response was heard over the room."

The description of a favorite social function is given in volume 40, page 442.

For some years the more cheerful and irrepressible members held a humorous session at the close of the meeting, which was called "Section Q" but was never recognized in the official proceedings. To-day our Section Q is Education, a very proper substitute. In later years frivolity is crowded out by the great volume and intensity of serious matter. But the British Association once had its humorous appendage. In the early years the effervescent spirits had their "Red Lion Club."

Forbes it was who gave them a species of constitution; their chairman became the Lion king; their new members on admission became cubs; the organizers of the arrangement, jackals. On rising to speak (or otherwise to entertain the company) they must roar and flourish their coat-tails as an introductory ritual; similar manifestations were prescribed to the audience as conveying applause or dissatisfaction.[3]

Occasional reference is made to the presence at the American meetings of eminent foreign visitors. Charles Lyell participated in the meeting of 1842. At the 25th meeting, 1876, Huxley made a brief address; and at the Montreal meeting of 1882, W. B. Carpenter read a paper on "The temperature of the Deep Sea."

Down to 1903 it was the expensive custom to print a separate program for each day's scientific and social events. That has become impossible with our larger and diversified meeting, and one comprehensive program covering the entire meeting, both of the association and of the many societies in conjunction, has proved satisfactory. These programs, on file in the office of the society, give much fuller accounts of the meeting than are found in the condensed reports of the secretaries.

[3]The British Association for the Advancement of Science, a Retrospect, 1831–1921. By O. J. R. Howarth, Secretary, London, 1922. The above quotation is from page 91. Some data relating to the British association, in later pages of the present writing, are derived from this interesting book.

In the earlier years it was the custom to hold general sessions of the whole association each morning, and sometimes in the afternoon, at which papers were read in addition to the administrative business. As late as 1900 business sessions were held in the morning, and to 1909 a session for business closed the meeting. When the association was small and many items of administration were handled by the association such sessions were not only necessary, but were desirable and helpful in both a scientific and a social way. As the association became larger and the administration was thrown on the council, with more time required for the science work, the general sessions were omitted except one at the beginning and one at the close of the meeting; and even the latter has been abandoned in recent years. Quite the only item of business now left to the general session is the passing on changes in the constitution.

The most radical change in the conduct of the association relates to the dates or season for holding the annual meetings. Previous to 1902 the 51 meetings were held in the summer, and mostly in August (except four very early ones in the spring). Beginning with December, 1902, they have been held in midwinter, during the holiday time. In order to hold the many technical societies in helpful relation to the association it was necessary to so plan the meetings in time and place as to secure cooperation and frequent convocations. The first of the large winter gatherings was in Washington, D. C., December 29, 1902, to January 3, 1903. Of this meeting the secretary reports: "One may assert with reasonable confidence that the gathering was the most representative and extensive which has ever been held under the auspices of any purely scientific association in this country, and stands in favorable comparison with any similar congress in other lands. . . . One may well affirm that the experiment of changing the time of meeting has proved a distinct success, and this is evident not only in the size of the gathering but in the characteristic features of the series of meetings as well." (52: 540).

The great convocations are held in the three cities of Washington, New York and Chicago, at four-year intervals, to which all national scientific societies are urgently invited. At the intervening even-numbered years the meetings are held in other large cities, to which the affiliated and associated societies are invited; while in the odd-numbered years the association meets in smaller cities, other societies being welcome, and some always present. Designation of places is made years in advance for the information of all societies. The success of this plan, which has evident difficulties, is, nevertheless, attested by the growth of the association in its membership, finances and influence during the past 20 years.

This difficult matter of time of meetings has often been discussed (53: 587–9), and has been ably considered in a recent report by a special committee, Dr. Cattell, chairman, made to the Boston meeting, 1922. This was printed in SCIENCE, volume 56, pages 616–620.

Older members recall the summer meetings with pleasure, and regret their passing. The thought was happily and humorously expressed by President Remsen at the first convocation.

> The scientific men of this country are to-day and this week making an experiment of national significance. To those who have been in the habit of attending the meetings of the American association, these meetings suggest summer excursions, rather hot weather, pleasant experiences in the open; they certainly do not suggest mid-winter. For the first time in its history, the association, at all events, meets in the winter time and in what is known, perhaps not to all, but certainly to the scientific men and university men of the country, as "Convocation Week." It has been found that the scientific men, the university and college teachers of the country, were hard put to it to pass their time between Christmas and New Year's day. It hung heavily on their hands. They were distressed. And so some of our good brethren got together and voted that we must have something to do; and they appointed the week in which the first of January occurs as "Convocation Week," in which we are all to come together and work, stop this idling and get rid of this sad period of the holidays. As I understand it, it is impossible for us, in the future, to think of spending the holidays with our families unless we bring our families with us, and sometimes there are difficulties in the way of that. This is the experiment we are making, and this is the first evidence of the results of that experiment. How it is going to work no one is able to say at the present time. We hope, however, that the meetings will be larger than in the past and that they will be fully as helpful and pleasant as in the past; though some of the features we have always had in mind as pertaining to the meetings of the American association will necessarily be lacking. (52: 556–557).

Much may be said for the summer meetings; the more favorable weather and cheerful travel; the opportunity for out-of-doors, excursions, garden parties, etc.; with the consequent social advantage. In this connection the summer meetings of the British association are always cited; but the comparison is unfair because of the wide difference in geographic and social conditions. It must be realized that the social pleasure of the old-time meetings was largely conditioned by the small attendance. Omitting a very few exceptional meetings, the registration to 1878 was usually less than 200, and to 1902 only a few hundred. The suggestion of two regular meetings every year is impracticable, for obvious reasons. Since 1902 five summer meetings have been held, with satisfaction to the few persons attending, and others are in prospect.

Summer meetings with their excursions and opportunity for field study were especially helpful to the natural science sections, and sections E, F and G may have suffered somewhat by the shift from summer to winter. However, there are compensating advantages. The winter meetings must have favored the other sections, as evidenced by the great increase in membership and attendance. It should be remembered that any section may hold independent meetings (52: 542), and they are desirable for the reason that smaller cities and isolated institutions can be visited which are unavailable for the whole association.

The article by Goode, mentioned in our first chapter, closes with a paragraph in italics that is interesting in this connection.

> A winter meeting would render it possible for all the kindred societies of specialists and professional workers to meet in connection with the American association, occasionally, or it may be each year. It would be a glorious occasion if, when the American association in 1898 enters upon the second half of its first century, it should have actually assumed its natural functions as the central agency for all American scientific effort. (40: 47).

The "glorious occasion" arrived in 1902, only four years beyond the date in Goode's prophetic conception.

With the shift from summer to winter the character of the annual meetings has changed conspicuously, in the greatly enlarged membership and registration, and the conjunction with many large technical societies. But the most important, if less evident, change lies in the scientific work of the association as related to the affiliated societies. During the first half century of its life the association was the national representative of science. Beginning about 1880 the stronger sciences, those dealing with material resources and related to commercialism, were outgrowing the facilities and financial limitations of the association and its sections. The chemists and the geologists were the first of the strong groups to set the example of separation. An early discussion of good and bad effects of the formation of special societies was made by the permanent secretary in his report for 1888 (37: 418–419).

The following statement gives the number of meetings in different cities:

Four times

Philadelphia, 1848, 1884, 1904, 1914
Washington, 1854, 1891, 1902, 1911.
Buffalo, 1866, 1876, 1886, 1896.
Boston, 1880, 1898, 1909, 1922.
New York, 1887, 1900, 1906, 1916.

Three times

Cincinnati, 1851, 1881, 1923.

Cleveland, 1853, 1888, 1912.
Baltimore, 1858, 1908, 1918.
Chicago, 1868, 1907, 1920.
St. Louis, 1878, 1903, 1919.

Two times

Albany, 1851, 1856.
Montreal, 1857, 1882.
Springfield, Mass., 1859, 1895.
Indianapolis, 1871, 1890.
Detroit, 1875, 1897.
Minneapolis, 1883, 1910.
Toronto, 1889, 1921.
Columbus, 1899, 1915.
Pittsburgh, 1902, 1917.

Once

Cambridge, 1849. Charleston, 1850. New Haven, 1850. Providence, 1855. Newport, 1860. Burlington, Vt., 1867. Salem, 1869. Troy, 1870. Dubuque, 1872. Portland, 1873. Hartford, 1874. Nashville, 1877. Saratoga, 1879. Ann Arbor, 1885. Rochester, 1892. Madison, 1893. Brooklyn, 1894. Denver, 1901. New Orleans, 1905. Ithaca, 1906. Hanover, 1908. Atlanta, 1913. San Francisco, 1915. Los Angeles, 1923.

Many important cities of America have not been visited by the association. The Pacific and the Southwestern divisions will feel responsible for the far-west and southwestern territory. Within the area left to the general association the following cities should be considered; while invitations would be welcomed from many other smaller cities.

For Winter Meetings

Birmingham	Mexico City	St. Paul,
Jersey City	Milwaukee	Toledo
Louisville	Newark	Wilmington.
Memphis	Richmond	

For Summer Meetings

Bridgeport,	New Bedford,	Syracuse,
Camden,	Omaha,	Trenton,
Des Moines,	Paterson,	Worcester,
Fall River,	Quebec,	Winnipeg,
Grand Rapids,	Reading,	Yonkers,
Lowell,	Scranton,	Youngstown.

Attendance.—We have no record of the registration at the first four meetings, nor of the seventh, at Cleveland, 1853. Omitting the two small meetings immediately after the civil war (Buffalo, 1866, and Burlington, Vermont, 1867), the registration of the remaining 45 summer meetings, to 1901, is grouped geographically as follows:

New England states, average of	9	meetings	380
Middle Atlantic states, average of	15	"	439
Central states, average of	12	"	284
Mississippi Valley states, average of	4	"	221
Southern states, average of	1	"	173
Far west states, average of	1	"	311
Canada, average of	3	"	570

21 winter meetings, beginning 1902, have had registration as follows:

New England states, average of	2	meetings	1,739
Middle Atlantic states, average of	9	"	1,125
Central states, average of	4	"	1,294
Mississippi Valley states, average of	3	"	595
Southern states, average of	2	"	342
Far West states, average of	0	"	0
Canada, average of	1	"	1,832

The largest registration of the summer meetings was at the second Philadelphia meeting, 1884, with 1,261, including 312 foreign guests. The first Boston meeting, in 1880, had a registration of 997.

Since 1913 five winter meetings have had registration exceeding 1,000, and two of them over 2,000. Chicago, in 1920, registered 2,412; but of this number only 1,383 were members of the association, 377 being from associated societies and 652 being guests. Our later meetings compare with the meetings of the British association, where 13 meetings in Scotland averaged 2,133, and 24 in northern England 1,955. Four meetings of the British association were over 3,000: Manchester, 3,838, in 1887; 3,138, in 1861; Newcastle-on-Tyne, 3,335, in 1863, and Liverpool, 3,181, in 1896. The large meetings of the British association are more justly compared with our winter convocations, taken as a whole, when only a portion of the attendance of the affiliated societies appears on the registration lists of the association. The total attendance at our greater convocations must far exceed the largest British registration.

One point of difference between the British and the American meeting is of importance. Our association has followed the "democratic" American custom of throwing all sessions open to the public without charge. The British association has been somewhat exclusive, and from its beginning their scientific and social functions have not been freely open to the public. Visitors, as local and temporary members, pay the regular annual charges. From the sale of membership tickets from 1848 to 1920 the British association realized the equivalent of over $705,000. One half of this was expended on grants for research. It may properly be questioned if our free gatherings are as well appreciated or as well attended as if they cost the visitor something. It is a trite saying, but true, that most people appreciate things in proportion to the cost.

During the great war the British association omitted meetings in 1917 and 1918. America being so far from the scene of conflict and relatively so little af-

fected, the American association dropped no meetings, but, on the contrary, the meetings were well attended. The demands of warfare were a stimulus to chemical and physical science.

Following the Columbus meeting of 1915, a special two-day meeting was held in Washington, in conjunction with the Pan-American Congress. This meeting is not listed with the series of annual meetings.

The delicate relation of the association to the technical societies and the difficult problem of meetings and of functions have been the subject of study by council and executive committee. Without hasty or radical action, but with patience and tolerance, the matter of the mutual relationship has been allowed to develop from year to year, and the present strength and influence of the association, as the general representative of science, and the success of the many societies in their special fields, appear to justify the conciliatory and laissez-faire policy.

The association claims as its field the whole of Pan-America. But it has never held a meeting south of New Orleans. In 1889, Professor Putnam proposed a meeting in Mexico (38: 481), and Brazil was favored by the council in 1913 (65: 464). In 1919, at Chicago, a committee was appointed "to cooperate with such organization as Mexican men of science may form." The Southwestern Division has carried the work to the Mexican border, and the El Paso meeting held a session across the boundary, in Juarez. It is hoped that the political conditions will soon admit of an organization in Mexico, and of association meetings in Mexico and Central America. It would be a happy event for science and for internationalism if a meeting could be arranged for some city in South America.

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(To be continued)

THE GROWTH OF LEGEND ABOUT SIR ISAAC NEWTON

(1) *The usual explanation of Newton's delay of about twenty years in announcing the law of gravitation* involves what appears to be one of the earliest legendary statements concerning Newton. In a publication issued the year after Newton's death, H. Pemberton[1] states that when Newton in 1666 first tested the gravitational hypothesis by applying it to the earth's attraction for the moon, he used too small a value for a degree of latitude on the surface of the earth (60 English miles instead of the more accurate value of 69½ miles obtained later by J. Picard) and found that "his computation did not answer expectation. On this account he laid aside for that time any further thoughts upon this matter." W. Whiston[2] refers to Pemberton's account and adds that Newton was "in some degree disappointed, . . . however, some time afterward," using 69½ such miles, he verified the law of gravitation. These accounts of the computation of 1665 or 1666 are in direct conflict with Newton's own statement[3] found by the astronomer Adams in the Portsmouth Collection of Newtonian manuscripts: "And the same year (1665) I began to think of gravity extending to y^e^ orb of the Moon and . . . I compared the force requisite to keep the Moon in her Orb with the force of gravity at the surface of the earth, and *found them answer pretty nearly.*" Newton does not state what value he took for a degree of latitude, but fairly accurate values were known at that time. Measurements of the earth had been made by Eratosthenes[4] and Posidonius[5] in the third century B. C., by the astronomers of Caliph Al-Mamun[6] in the ninth century A. D., by J. Fernel in 1528, W. Snell in 1617, R. Norwood in 1635. Most of these early measurements were in excess of the modern values, some by as much as 13½ per cent. On the other hand, it is true that English seamen used 60 miles to the degree; this was thought sufficiently accurate for their purposes. It was very convenient in computation, for 60 miles per degree of latitude meant one mile per minute. Thus R. Norwood[7] used 60 miles in his "Trigonometrie" of 1631, and again in the edition of 1678, notwithstanding the fact that he himself in 1635 had found the degree to exceed 69 miles. Moreover, Edmund Gunter and William Oughtred[8] call special attention to the inaccuracy of 60 miles. Gunter[9] says in 1624, "I find that we may allow 352000 feet [66 2/3 miles] to the degree." Oughtred[10] (we suspect from what he says,

[1] H. Pemberton, "View of Sir Isaac Newton's Philosophy," London, 1728, Preface; W. W. R. Ball, Essay on Newton's "Principia," London, 1893, p. 10; Sir David Brewster, "Memoirs of . . . Sir Isaac Newton," 2 Ed., Edinburgh, 1860, Chap. II, p. 23.

[2] Memoirs of the Life of Mr. William Whiston by himself, London, 1749, I, p. 35.

[3] W. W. R. Ball, *op. cit.*, p. 7.

[4] Sir Th. Heath, "History of Greek Mathematics," Vol. 2, Oxford, 1921, p. 107; Encyklopädie d. Math. Wissensch., Vol. VI, 1, 1907, p. 223.

[5] Sir Th. Heath, *op. cit.*, p. 220; Encyklopädie, Vol. VI, 1, 1907, p. 223.

[6] Encyklopädie, Vol. VI, 1, 1907, p. 224.

[7] Richard Norwood, "Trigonometrie," 1631, p. 102; edition of 1678, p. 147.

[8] Newton as a boy studied one of Oughtred's books and later commented favorably on Oughtred's plans for the education of navigators.

[9] "Works of Edmund Gunter," 5 Ed., London, 1673, p. 280, 281.

[10] W. Oughtred, "The Circles of Proportion," trans. into English by W. Forster, "Addition," London, 1633, p. 21, 27.

that he himself had made crude earth-measurements), in 1633, took 66½ miles. These figures are somewhat below those of Snell and Fernel, but would have yielded fairly accurate results in Newton's computation. In the edition of 1657 of Edward Wright's "Certaine Errors in Navigation," 60 miles are given for 1° of latitude in the body of the book, but in an appendix are given about 66 1/3 miles.[11] It appears that none of the measurements, either ancient or modern (except one of the two estimates made by Posidonius) fell as low as 66 English miles to the degree of latitude. Moreover, Richard Norwood published the results of his measurements (69.5 miles per degree) in his "Seaman's Practice," in 1636, a book whose popularity is attested by the fact that it reached its seventh edition in 1667. It should be noted that Norwood, Wright, Gunter and Oughtred were among the most prominent mathematicians of the first half of the seventeenth century in England.

To claim that Newton took 60 miles in a computation requiring great accuracy is like saying that he would take the value 3, instead of 3.14159, for π, when endeavoring to reach very close approximations to circular areas.

But this is not all. Suppose for the sake of argument, Newton had actually used 60 miles in 1665, he knew in 1672 (as we shall see) that this value was too small. Yet not till about thirteen years after 1672 did he announce his law of gravitation. Why should he have waited that long, if the size of the earth had been the real cause of his difficulties in verifying the law of gravity? We know from at least one source that in 1672 Newton had a knowledge of the best earth-measurements. On January 11 and February 1, 1672, Picard's value[12] (69½ miles to the degree) was mentioned at meetings of the Royal Society. Newton was not present at the first meeting and perhaps not at the second.[13] However, an account of Picard's measurements appeared in the *Philosophical Transactions* for 1675, Vol. 10, p. 261. Again, in 1672, there appeared at Cambridge Newton's own edition of Varenius's "Geographia," which devoted a whole chapter to methods of finding the size of the earth and contained the results reached by Eratosthenes, Posidonius, the Arabic astronomers and Snell.

In 1888 the astronomer J. C. Adams and the mathematician J. W. L. Glaisher came to the conclusion from the study of the Portsmouth Collection of Newton's manuscripts and of his correspondence, that Newton's real difficulty in verifying the law of inverse squares had been not the size of the earth, but the question how a sphere attracts an outside particle.[14] Does the sphere attract as if all its mass were concentrated at its center, or in some other way? In a letter of June 20, 1686, to Halley, Newton said that the previous year (1685) he had been able to clear up this matter. His conclusion is found in his "Principia," Bk. I, Prop. 91.

The investigations of Adams and Glaisher have not received due attention and the legendary account of Pemberton and Whiston is still widely accepted.

(2) *Alleged delay in publication of the "Principia":* A legend of recent origin is that Halley and Wren held up the publication of Newton's "Principia" three years, because Newton would not give credit to Robert Hooks for his prior discovery of the law of universal gravitation. No authority is given for this statement. It is true that when the manuscript of the first book of the "Principia" was presented to the Royal Society, Hooke entered a claim of priority. It is true that there was a correspondence relating to Hooke's claim, and that Newton finally made an acknowledgment. But that it took three years of effort on the part of Halley and Wren to bring this about is wholly untrue. Halley's troubles were different in character. Fearing further controversies, Newton wrote him once, "The third [book] I now design to suppress."[15] Halley needed all the ingenuity at his command to prevent Newton from withdrawing the third book from publication. The manuscript of the first book of the "Principia" was presented to the Royal Society, April 28, 1686, the last part reached Halley in April, 1687; the "Principia" appeared from the press that same year.[16] Instead of a delay of three years, there was a speed of publication quite exceeding that of recent years.

(3) *Was Newton an inventor of the reflecting telescope?* A noted American critic of mathematical books has asserted recently that Newton did not invent the reflecting telescope but simply constructed such telescopes. As authority for this claim the critic refers to the article "Telescope" in the Encyclopedia Britannica, where emphasis is placed upon the fact that, unlike James Gregory and other theoretical inventors of the reflecting telescope, Newton actually constructed such an instrument. A full and explicit statement is made in the article "Newton," where Newton is credited with the invention. One finds important features of design in Newton's instrument which are contained in none of the previous theoretical designs. Students of history know, of course, that most great inventions and discoveries have been

[11] W. W. R. Ball, *op. cit.*, p. 15, 16.

[12] S. P. Rigaud, "Historical Essay on . . . Sir Isaac Newton's Principia," Oxford, 1838, p. 9.

[13] S. P. Rigaud, *op. cit.*, 1838, p. 7.

[14] *Cambridge Chronicle*, April 20, 1888; W. W. R. Ball, *op. cit.*, p. 16, 17.

[15] Weld's "History of the Royal Society," Vol. I, p. 311.

[16] S. P. Rigaud, *op. cit.*, p. 31, 84.

reached by more than one investigator. A description of Newton's instrument was read before the Royal Society, and it was ordered that a letter should be written by the secretary assuring Newton "that the society would take care that all right should be done him with respect to this invention." The telescope which he presented to the society is carefully preserved and carries the inscription, "The first reflecting telescope invented by Sir Isaac Newton, and made with his own hands."[17] Newton acknowledged that he had been acquainted with the telescope proposed by Gregory, before he contrived his own; nevertheless, certainly no one has greater claim to being called an inventor of a reflecting telescope than Newton.

(4) *Action at a distance:* In the preface to the second edition of the "Principia," 1713, the editor, Roger Cotes, advances the doctrine of "action at a distance." Through lack of discrimination, Cotes's doctrine came to be ascribed to Newton himself, even though Newton nowhere expresses his adherence to this doctrine. On the contrary, in a letter to Bentley, February 25, 1692, Newton says:[18] "That gravity should be innate, inherent and essential to matter, so that one body may act upon another at a distance through a vacuum, without the mediation of anything else . . . is to me so great an absurdity, that I believe no man, who has in philosophical matters a competent faculty of thinking, can ever fall into." In his "Opticks" (Queries, 18, 22) Newton postulated the existence of an ether. In this century a new meaning is attached to the phrase "action at a distance." Instead of being used in the old sense with reference to the non-existence of a medium intervening between attracting masses, it is now used to indicate an instantaneous action at a distance. In place of an agent we now consider the time of action. But even now the view of Newton is misrepresented. Albert Einstein[19] speaks of "Newtonian action at a distance" as "immediate action." Newton, on the other hand, postulates an agent and gives it time to act. To be sure, in his calculations of gravitational attractions, he assumes, as a necessary approximation, that the action is instantaneous, but not so in his talks on gravity. In a letter to Boyle[20] he considers the cause of gravitation between two approaching bodies.

They "make the ether between them begin to rarify." And again,[21] "So may the gravitating attraction of the earth be caused by the continual condensation of some other such like ethereal spirit," . . . in such a way, . . . "as to cause it [this spirit] from above to descend with great celerity for a supply; in which descent it may bear down with it the bodies it pervades, with force proportional to the superficies of all their parts it acts upon."

(5) *Wave hypothesis of light:* The impression is widespread that Newton rejected the wave hypothesis when he advanced his emission hyopthesis. Such is not the case. He showed that the phenomena of colors formed by thin plates might be explained as undulations. With great hesitation did he argue against the wave hypothesis. "'Tis true," he says, "that from my Theory I argue the Corporeity of Light, but I do it without any absolute positiveness, as the word *perhaps* intimates; and make it at most but a very plausible consequence of the Doctrine." And again, "it has a much greater Affinity with his [the objector's] own Hypothesis, than he seems to be aware of; the Vibrations of the Aether being as useful and necessary in this, as in his."[22] Little did Newton suspect that for a whole century his followers would dogmatically insist upon the emission hypothesis and would flatly reject all other explanations, and that even in the twentieth century his study of the possibilities of the wave hypothesis would be overlooked.

Florian Cajori
University of California

[17] Sir David Brewster, *op. cit.*, Vol. I, 1860, p. 40–46.

[18] "Correspondence of R. Bentley," Vol. I, p. 70; Kelvin in *Proceed. of Royal Society of London*, Vol. 54, 1893, p. 381. See also S. P. Rigaud, *op. cit.*, Appendix, p. 62, 69.

[19] A. Einstein, "Sidelights on Relativity," transl. by G. B. Jeffery and W. Perrett, London, 1922, p. 4, 5, 17, 18.

[20] "Horsley's Newton," Vol. 4, p. 385; S. P. Rigaud, *op. cit.*, App., p. 62–65.

[21] S. P. Rigaud, *op. cit.*, App., p. 69, 70.

[22] *Philos. Trans. Abr.*, Vol. I, p. 146. Quoted in G. Peacock, "Miscellaneous Works of the Late Thomas Young," Vol. I, p. 145, 146.

SCIENTIFIC EVENTS

THE PRESIDENT'S COMMISSION ON OIL RESERVES

The President's Commission on Oil Reserves has organized with George Otis Smith as chairman, and Lt. Commander M. C. Robertson has been assigned by the Secretary of the Navy to serve the commission as its secretary. After calling on President Coolidge the commission issued a statement saying:

> The policy under which the President's Commission on Oil Reserves has been appointed and under which it approaches its task is the definite policy of conservation in aid of national security.
>
> The present is a period of overproduction of oil, but an approaching shortage of American oil can be surely forecast, for consumption is rapidly increasing and already production has begun to drop from the high figures of last year. American wells can not long continue to supply the bulk of the world's needs. Conservation

measures are the part of wisdom; practices that will make for thrift in the use of oil may well be adopted by many industries and the general public, but the plan of reserving of oil for use in national defense even more insistently demands public approval.

The President's Commission regards the needs of the Navy as fundamental to its study of the situation but, at the same time, fully appreciates the broader aspect as to the whole question of national security and prosperity.

The Navy itself is a national insurance policy and adequate reserves of the best fuel for the Navy form an indispensable part of this provision for the national security.

The naval oil reserves were created with the declared purpose that the government retain ownership of as large tracts of oil lands as could be then found, so as to provide for any future needs of the Navy. The original intent, declared in a time of plenty, was to store oil where nature placed it against the time when oil in the quantities then needed could not be had through the ordinary trade channels. This purpose was later reiterated by the General Board of the Navy in its study of national defense by recommending "the purchase of oil for the Navy's needs as long as it is possible to do so, thus deferring the tapping of the Navy's reserve until the last moment."

When the time comes that American industry and commerce are forced to depend in large part upon foreign oil, the American Navy, as well as other arms of national defense, should have its reserves of American oil to fall back upon. Any other policy would endanger national security.

ADVISORY COMMITTEE TO THE LAKE STATES FOREST EXPERIMENT STATION

SECRETARY WALLACE, of the U. S. Department of Agriculture, has just appointed the advisory committee to the Lake States Forest Experiment Station. This committee consists of representatives of forest industries and state institutions and departments concerned with the forest problems of the Lake States. The individuals on the committee were nominated by their respective organizations and appointed to serve on the committee by Secretary Wallace.

The function of this committee will be advisory to the Lake States Forest Experiment Station in passing upon forest research most urgent for the region, correlating forest research throughout the region, and in any other way to promote forest research throughout the Lake States. Each of the members of the Advisory Committee has had wide experience with the forest problems now confronting the Lake States Station and the committee should prove of great assistance in advancing the work of the station. The following list names the members of the committee and the organization which each represents.

MICHIGAN

Herman Lundeen, Michigan Department of Conservation and Michigan Hardwood Manufacturers' Assn.
Professor L. J. Young, University of Michigan.
Professor A. K. Chittenden, Michigan Agricultural College.
John M. Bush, Upper Peninsula Development Bureau.
George A. Newett, Lake Superior Mining Institute.

MINNESOTA

G. M. Conzet, Minnesota Forest Service.
Dean W. C. Coffey, Department of Agriculture, University of Minnesota.
H. C. Hornby, Northern Pine Manufacturers' Association.

WISCONSIN

C. L. Harrington, Wisconsin Conservation Commission.
Dean H. L. Russell, Wisconsin Agricultural College.
A. L. Osborn, Northern Hemlock and Hardwood Manufacturers' Assn.
D. C. Everest, Wisconsin Protective Association.

AT LARGE

E. E. Parsonage, Association of Wood-Using Industries.
D. C. Everest, American Paper and Pulp Association.

The general problems of the region have been presented to the members of the committee by the experiment station in order that they may familiarize themselves with the entire scope of the station's work. At the first meeting of the advisory committee to be held at the Cloquet Forest of the University of Minnesota, on May 19, the most important problems of the region will be selected and suggested to the experiment station as urgent problems. The program of work for the station will then be based largely upon the recommendations of the Advisory Committee.

The Lake States Forest Experiment Station of the U. S. Forest Service was established last fall to study the forest problems of the Lake states and to lead the way for forestry in the region. Headquarters for the station have been established at the University Farm of the University of Minnesota at St. Paul and several field stations have been located throughout the region from which active investigations will be conducted into the forest problems of Minnesota, Michigan and Wisconsin.

RAPHAEL ZON,
Director

UNIVERSITY FARM,
ST. PAUL, MINN.

FELLOWSHIPS IN PROBLEMS OF NUTRITION

ON the basis of a contribution by the National Live Stock and Meat Board, the National Research Council announces the establishment of two fellowships

for one year in the study of problems in nutrition. These fellowships are to be known as the National Live Stock and Meat Board Fellowships of the National Research Council. The stipend of each fellowship is $2,400, with $300 additional to aid in covering the expenses of investigation. The administration of the fellowships has been placed in the hands of a committee of the division consisting of Dr. E. B. Forbes, chairman; Dr. C. Robert Moulton, and Dr. H. C. Sherman, from the committee on food and nutrition of the National Research Council. The committee proposes the following two subjects for investigation:

(1) The comparison of meat with other foods for blood regeneration.

(2) The comparison of meat with other high-protein foods in reproduction and lactation—to be studied by adding the high-protein foods to a basal mixed diet composed of ordinary foods.

The fellowships are open to applicants of promise, either men or women, and the awards will be made in accordance with the evidence submitted of ability to investigate the particular problems chosen, and the promise of success in the research as influenced by the choice of the laboratory in which the candidate proposes to carry on the study.

The work of the fellows is to begin on July 1, or as early thereafter as possible. Applications must be in the hands of the committee by June 1. Application blanks may be obtained from the executive secretary of the Division of Biology and Agriculture, National Research Council, Washington, D. C.

THE ACTIVITIES OF THE ROCKEFELLER FOUNDATION

THE following table presents a summary of the expenditures in 1923. A full financial statement will appear in the Foundation's Annual Report, which will be sent to any one who applies for it.

PUBLIC HEALTH	
International Health Board—hook-worm disease, malaria, yellow fever, county health work, laboratory service, fellowships, etc.	$2,332,511
Mental hygiene	52,153
Hospital, Dispensary, and Nursing Studies	161,504
School of Public Health, Harvard University	618,750
National Health Council	9,350
MEDICAL EDUCATION	
China Medical Board	1,354,942
Canadian Medical Program	1,596,592
London Medical Center	621,472
University of Chicago	1,046,952
Columbia University	8,333
Central Europe—Journals and Apparatus	60,316
Pasteur Institute	20,000
Fellowships, studies, etc.	202,403
MISCELLANEOUS	
Concluding payments on ten-year pledges to educational enterprises	37,500
Concilium Bibliographicum, Zürich	20,000
Fellowships in Physics, Chemistry, and the Biological Sciences	97,428
National Information Bureau	1,000
ADMINISTRATION	
Executive offices	189,869
Total	$8,431,075

THE SECOND NATIONAL COLLOID SYMPOSIUM

THE second National Colloid Symposium will meet in Evanston, from June 18 to 21, as joint guests of Northwestern University and the Chicago Section of the American Chemical Society. The program will be in charge of the Committee on the Chemistry of Colloids of the National Research Council under the chairmanship of Professor Harry N. Holmes, of Oberlin College.

The symposium will commence at two o'clock on Wednesday afternoon, June 18. Papers will be given on Wednesday afternoon, Thursday morning and afternoon, Friday morning and afternoon, and Saturday morning. Special entertainment features are planned for Wednesday evening. Thursday evening will probably be left free for informal meetings. On Friday evening the visiting colloid chemists are to be invited to the June meeting of the Chicago Section. A special program is planned for that evening.

Arrangements have been made for the use of the Northwestern dormitories during the symposium. These dormitories are pleasantly located near the shore of Lake Michigan.

The program as arranged to date is as follows:

A. V. Bleininger, of the Homer Laughlin China Company, Newell, West Virginia, on "The properties of clays."

Eugene C. Bingham, of Lafayette College, on "Fluidity and plasticity in colloid control."

W. D. Harkins, of the University of Chicago, on "Oriented adsorption."

E. O. Kraemer, of the University of Wisconsin, on "Brownian movement in gels" (with movie demonstration).

F. P. Hall, of the Massachusetts Institute of Technology, on "The effect of hydrogen-ion concentration on clay suspensions."

G. S. Whitby, of McGill University, on "The colloid chemistry of rubber." Exact title to be announced later.

George Bouyoucos, of the Michigan Agricultural College, on "Soil Moisture."

John Arthur Wilson, of Milwaukee, on "Activated sludge method of sewage disposal."

Harry N. Holmes, of Oberlin College, on "Emulsions."

Ross A. Gortner, of the University of Minnesota, on "Some aspects of acid and alkali binding by proteins."

Neil E. Gordon, of the University of Maryland, on "Soil adsorption."

Jerome Alexander, of New York, on "Bentonite and other colloidal clays."

Arthur I. Kendall, of Northwestern Medical School, on "Bacteria as colloids."

W. J. Kelley, of the Goodyear Rubber Company, on "The determination of size of particles and their distillation."

About six more papers are planned for the program. It is also hoped that a distinguished colloid chemist from abroad will attend as the guest of honor of the symposium.

THE STANFORD UNIVERSITY MEETING OF THE PACIFIC DIVISION AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE eighth annual meeting of the Pacific Division American Association for the Advancement of Science will be held at Stanford University June 25 to 28, 1924. The preliminary announcement just issued contains an interesting sketch of Stanford University, setting forth briefly its physical characteristics together with its educational advantages and equipment. As one of the great educational institutions of the west and a widely recognized center of research activities it is peculiarly adapted for the meetings of the various scientific societies which will hold sessions under the auspices of the Pacific Division. The large resident membership in the vicinity of California's two great universities assures good representation at this meeting and a general program of extraordinary interest has been arranged.

The usual research conference will be held at which it is planned to discuss several outstanding pieces of research which have been in progress during the year.

On Wednesday afternoon, June 25, a symposium will be presented on "Food Problems" with the following subjects and speakers:

(1) *Food economics.* Dr. Alonzo E. Taylor, director of the Food Research Institute, Stanford University.

(2) *Disposition of California food products.* Ralph P. Merritt, regent, University of California.

(3) *The vitamine problem.* Dr. H. M. Evans, professor of anatomy, University of California.

(4) *Aspects of the food situation in the Orient.* Dr. E. D. Merrill, professor of agriculture and dean of the College of Agriculture, University of California.

The address of the retiring president, Dr. David Starr Jordan, will be given on Wednesday evening, June 25, following an address of welcome by President Ray Lyman Wilbur, of Stanford University, and response by Dr. C. E. Grunsky, chairman of the executive committee. President Jordan will speak on "Science and sciosophy."

Following the address of the president the usual public reception will be held.

A feature of the general sessions will be an address by the distinguished parasitologist, Dr. George Henry Falkiner Nuttall, of Cambridge University, England. Dr. Nuttall will speak on "Symbiosis" on Thursday evening, June 26.

Various excursions of scientific interest have been planned for Friday and Saturday, among which may be mentioned one to Lick Observatory. A cordial invitation has been extended to all members to visit the observatory on Friday evening, June 27. Transportation and a picnic luncheon will be provided and the evening will be set aside for the entertainment of the guests.

The university dormitories on the campus will be available at reasonable prices for sleeping accommodations and ample provision will be made for the comfort and entertainment of visitors.

The following scientific societies are scheduled to hold meetings during the convention:

American Chemical Society, California Section
Southern California Section
American Meteorological Society
The American Physical Society
Astronomical Society of the Pacific
The Ecological Society of America
Pacific Coast Entomological Society
Pacific Coast Branch, Society for Experimental Biology and Medicine
Pacific Division of the Plant Physiological Section of the Botanical Society of America
Pacific Slope Branch, American Association of Economic Entomologists
Seismological Society of America
Society of American Foresters
Utah Academy of Sciences
Western Society of Naturalists
Western Society of Soil Management and Plant Nutrition

SCIENTIFIC NOTES AND NEWS

ERNEST FOX NICHOLS, director of research, Nela Research Laboratories, Cleveland, died in Washington on the morning of April 29, while reading a paper before the National Academy of Sciences.

G. STANLEY HALL, president emeritus of Clark University, distinguished for his contributions to psychology, died on April 24, aged seventy-eight years.

PROFESSOR O. W. RICHARDSON, of King's College, London, has been appointed to be the third Yarrow research professor of the Royal Society. He will remain a member of King's College and will continue to carry out his researches in the physics laboratory of the college. Prior to Professor Richardson's appointment as Wheatstone professor of physics at King's College, in 1913, he was professor of physics at Princeton University.

THE University of Paris has decided to confer honorary doctorates in the faculty of science on Professor H. A. Lorentz, University of Leyden, and Dr. C. D. Walcott, secretary of the Smithsonian Institution.

AT the annual meeting of the Chemical Society of London on March 27, the president of the society, Dr. W. P. Wynne, presented the Longstaff Medal to Professor F. G. Donnan, in recognition of his contributions to physical chemistry.

A COMMITTEE has been formed in Rome, composed of friends, colleagues and admirers of Senator Professor Battista Grassi, which hopes to commemorate the seventieth birthday of that famous worker in biological science and at the same time the fortieth anniversary of his uninterrupted teaching. The committee is raising funds for a "Grassi Foundation for Zoological Studies of Parasitic Diseases." The secretary of the committee is Cav. Paola Luigioni, Via della Dogana Vecchia, 27, Rome (19), to whom subscriptions should be sent. Subscriptions from the United States will be welcomed.

THE Scientific Societies meeting in Buffalo during the second week in April elected presidents as follows: The American Association of Anatomists, Professor Florence R. Sabin, of the Johns Hopkins Univeristy; The American Association of Pathologists and Bacteriologists, Dr. H. E. Robinson, of the Mayo Clinic, Rochester, Minn.; The American Association for Cancer Research, Dr. Erwin F. Smith, of the U. S. Department of Agriculture; The American Association of Immunologists, Professor Frederick G. Novy, of the University of Michigan; The Association of Medical Museums, Major James Coupal, of Washington, D. C.

THE twenty-first annual (139th) meeting of the Society for Experimental Biology and Medicine was held at the College of the City of New York on April 16 at 5 P. M. Eight papers were read and twelve presented by title. The annual dinner, held at 7:15 P. M., was made the occasion of memorial remarks for the late past-president of the society, Jacques Loeb. Appreciations of Dr. Loeb's ideals and contributions to science were given by Drs. A. J. Goldfarb, A. R. Moore and D. D. Van Slyke. Officers elected for 1924-25 were: *President,* Holmes C. Jackson; *Vice-President,* James W. Jobling; *Secretary-Treasurer,* Victor C. Myers, and *Councilor,* 1924–26, Peyton Rous. The Nominating Committee elected for the next academic year is composed of W. R. Bloor, A. J. Goldfarb, L. B. Mendel, C. P. Sherwin, D. D. Van Slyke, G. B. Wallace and Hans Zinsser.

AT the ninth annual convention of the American Association of Petroleum Geologists, held March 26 to 28, James H. Gardner, president of the Gardner Petroleum Co., of Tulsa, Okla., was elected president.

DR. R. C. WALLACE, professor of geology in the University of Manitoba, has been elected president of the Canadian Institute of Mining and Metallurgy.

DR. FRANK D. ADAMS, vice-president of McGill University, dean of the faculty of graduate studies and of the faculty of applied science, and professor of geology, has tendered his resignation and will leave McGill at the end of the present academic year, after completing a service that extends over a period of thirty-five years.

DR. GEORGE E. DE SCHWEINITZ has resigned as professor of ophthalmology in the Medical School of the University of Pennsylvania.

PROFESSOR CHARLES-EDWARD A. WINSLOW, chairman of the Department of Public Health, of the Yale School of Medicine, and Professor Ira V. Hiscock, of the department, are in Minneapolis, Minnesota, where they have been invited by the Council of Social Agencies to make a study of the health machinery of the city.

DR. GEORGE W. MCCOY, surgeon, U. S. Public Health Service, has been appointed consultant to represent the United States on the Permanent Standards Committee for the Standardization of Sera and Serologic Tests.

DR. MARSTON T. BOGERT, professor of organic chemistry at Columbia University, has been elected chairman of the National Research Council committee on chemical research on medicinal substances.

ASSOCIATE PROFESSOR WILMER E. DAVIS, of the department of botany and plant pathology, of the Kansas State Agricultural College, has been granted a year's leave of absence, beginning on September 1, in order to accept an invitation to join the staff of the Thompson Institute for Plant Research, Yonkers, New York. He will devote his time to the completion of several manuscripts and to work on some problems in connection with seed germination.

DR. ALBERT BARRETT MEREDITH, state commissioner of education for Connecticut, has been appointed a trustee of the Peabody Museum of Yale University.

SHELBY M. HARRISON, director of the department of surveys and exhibits, in charge of the studies of social conditions of the regional plan of New York and its environs, has been appointed vice general director of the Russell Sage Foundation.

DR. CASSIUS JACKSON KEYSER, Adrian professor of mathematics, and Edward Kasner, Ph.D., professor of mathematics in Barnard College, will represent Columbia University at the International Mathematical Congress to be held in Toronto during August, 1924.

PROFESSOR ELLSWORTH HUNTINGTON, of Yale University, who sailed last May as a delegate to the Pan-Pacific Science Congress, recently returned to the United States after visiting Japan, China, Java and Australia.

PROFESSOR KOTARO HONDA, professor of physics and metallurgy in the Iron and Steel Research Institute of the Imperial University at Sendai, Japan, recently visited the United States on his way to attend the spring meeting of the Iron and Steel Institute, England.

THE Argentine public health service has invited Dr. Muehlens, professor at the Institute for Tropical Diseases at Hamburg, to study the malaria situation in Argentina.

DR. ALBERT EARL VINSON, professor of agricultural chemistry in the University of Arizona, and chemist in the Experiment Station, has been appointed chemist in a scientific institute which is being organized at Port au Prince, Haiti, of which Dr. George T. Freeman, formerly of the Arizona College of Agriculture, is the director.

C. H. BAILEY, professor of agricultural biochemistry in the University of Minnesota and director of the Minnesota State Experimental Flour Mill, has been granted a leave of absence for one year for research and experiment work for the Biscuit and Cracker Manufacturers' Association. He will be stationed in New York.

PROFESSOR R. A. MILLIKAN, of the California Institute of Technology, will give three lectures in Buffalo on the evenings of May 5, 6 and 7 under the auspices of The Buffalo Society of Natural Science, Canisius College and the University of Buffalo. The titles of the lectures are: "Modern atomic theories," "Filling the gap between light and X-ray," "Pulling electrons out of atoms."

ON the evening of April 17, Dr. Arthur L. Day, director of the Geophysical Laboratory of the Carnegie Institution, delivered the annual Sigma Xi lecture at Swarthmore College. He spoke on "Some causes of volcanic activity."

THE titles of the Lane Medical Lectures to be delivered by Professor Ludwig Aschoff, professor of pathology of the University of Freiburg, at Stanford University Medical School, San Francisco, from May 26 to 30 are as follows: Place of origin of the biliary pigment; Arteriosclerosis; Ovulation and menstruation; the morphology and function of the adrenal cortex; fatty degeneration.

IN honor of the distinguished service of the late Henry Marion Howe, who was professor of metallurgy in Columbia University from 1897 to 1913, the title of his successor, William Campbell, Sc.D., has been changed to Howe professor of metallurgy.

A CORRESPONDENT writes: George A. Smith, for twenty-four years chief of the Dairy Division of the New York State Agricultural Experiment Station at Geneva, has died at the home of his daughter in Kingston, N. Y., at the age of eighty-two years. Mr. Smith retired from active work in November, 1921. While directing the dairy work at the Experiment Station, Mr. Smith contributed much to the practical solution of many dairy problems. His most notable contribution was probably in the demonstration that tuberculosis could be eliminated from a dairy herd by means within the reach of every dairy farmer. The station herd was freed from tuberculosis in 1906, and since then there has never been a demonstrated case in the herd. Mr. Smith also contributed much toward the solution of problems in cheese making.

THE *Journal* of the Washington Academy of Sciences reports that Benjamin A. Colonna, an officer of the Coast and Geodetic Survey from 1870 to 1885, died in Washington on March 11, 1924, at the age of eighty years. He was promoted through all grades of the service, but was disabled by an accident while on field work in the Strait of Fuca, and never completely recovered his health. In recent years he had been engaged in private business in Norfolk and Washington.

ALBERT HUGH JONES, the English entomologist, who made important contributions to science while engaged in banking, has died at the age of eighty-four years.

PROFESSOR T. RITTENER, author of works on geology and glaciology, died at Ste. Croix, Switzerland, on April 9, aged sixty-seven years.

THE autumn meeting of the American Chemical Society will be held at Cornell University from September 8 to 13.

THE third Pan-American Scientific Congress will meet in Lima, Peru, on November 16, 1924. The congress is composed of nine sections as follows: (1) Anthropology, history and related sciences; (2) physics, mathematics and related sciences; (3) mining, metallurgy, economic geology and applied chemistry; (4) engineering; (5) medicine and sani-

tation; (6) biology, agriculture and related sciences; (7) private, public and international law; (8) economics and sociology; (9) education.

A PUBLIC Health Congress, organized by the Royal Institute of Public Health, will be held from June 4 to 9, at Bordeaux, under the presidency of Lord Burnham. The presidents of sections include Sir Humphrey Rolleston, Sir Ronald Ross and Sir John Bland-Sutton.

THE United States Civil Service Commission announces the following open competitive examination: Physicist, $3,800 to $3,600 a year; associate physicist, $3,000 to $3,600 a year; assistant physicist, $2,400 to $3,000 a year. Applications will be rated as received until July 1. The examinations are to fill vacancies in the Bureau of Standards, Department of Commerce, and vacancies in positions requiring similar qualifications, at the entrance salaries stated above. Competitors will be rated on the following optional subjects: Heat, electricity, mechanics, optics, radio, physical metallurgy and any specialized work in the field of physics not included in any of the above. The work of the Bureau of Standards includes many branches of physics, chemistry, engineering and technology, such as mechanics, heat, optics, electricity, sound, metrology, metallurgy, radio, electronics, engineering (gas, electrical, mechanical, etc.), and offers valuable experience in these professions, combining as it does theoretical, experimental and practical work. The duties of these positions are in connection with original investigations in some field of the bureau's work. Competitors will not be required to report for examination at any place, but will be rated on their general education and experience, special education and training in physics and mathematics, and writings to be filed with the application.

UNIVERSITY AND EDUCATIONAL NOTES

BROWN UNIVERSITY receives a bequest of $250,000 by the will of the late John B. Hegeman, former president of the Metropolitan Life Insurance Company, for the erection of a hall of residence for students.

PROPOSALS for linking up Sheffield University with technical schools in the iron and coal districts round the city were adopted at a recent meeting of the council of the university. Two schools, Barnsley Technical School and Scunthorpe Central and Evening Technical School, are affected for the present, and it will be possible for students in engineering, metallurgy and mining there to begin training for degrees or associateships, under the recognition of the university.

AT Yale University Dr. J. Crosby Chapman has been promoted to a full professorship of educational psychology and Dr. Raymond Garrison Hussey has been advanced to an associate professorship of pathology.

WILLIAM S. FOSTER, A.B., Ph.D. (Cornell), who has been at the University of Minnesota since 1919, has been promoted to a professorship of educational psychology.

L. GRANT HECTOR has been appointed assistant professor of physics at the University of Buffalo. Mr. Hector is completing his work for the doctor's degree at Columbia University this year.

F. E. FARNSWORTH, Ph.D. (Wisconsin), has been elected to an associate professorship at the University of Maine. Mr. Farnsworth has been an instructor at the University of Pittsburgh, and during the past two years has been National Research Fellow at the University of Wisconsin.

DR. REYNOLD A. SPAETH, associate professor of physiology at the School of Hygiene and Public Health, Johns Hopkins University, has accepted a three year appointment from the Rockefeller Foundation as visiting professor of physiology at the reorganized Medical School of Chulalongkorn University in Bangkok, Siam. Dr. Spaeth and his family expect to arrive in Bangkok in November, but instruction will not begin until May, 1925.

PROFESSOR HANS SPEMANN, of the University of Freiburg, has been called to the chair of zoology and comparative anatomy in the University of Munich, as successor to Richard Hertwig.

PROFESSOR MARTIN GILDEMEISTER, of Berlin, has been called to the chair of physiology in the University of Leipzig to succeed the late Professor S. Garten.

DISCUSSION AND CORRESPONDENCE

LEIDY AND MARSH

WHILE reading Professor Osborn's memorial address, "Joseph Leidy, Founder of Vertebrate Paleontology in America,"[1] I was greatly astonished to see that he doubts "if you will find in the writings of . . . Professor Marsh a single allusion to the work of Leidy." Further, that in the rivalry between Cope and Marsh, "Leidy was totally forgotten." Remembering the warm words Marsh spoke to me

[1] Science, February 22, 1924, p. 175.

of Leidy, while I was at Yale in 1892, I felt that this statement was indeed "subject to verification," as its author later remarks.

That Leidy and Marsh were good friends is apparent, first of all, from the letters written by Leidy to Marsh during the years 1867 to 1890, and now in our museum archives, and equally so from the praise of Leidy that Marsh is known to have spoken at New Haven and elsewhere. Moreover, anyone who will take the time to go through Marsh's many publications will find many references to Leidy and his species, ranging all the way from 1868 to 1893. In none of these cases does he differ much with Leidy, and in one instance, at least, he speaks gratefully of bird material loaned him from the Philadelphia collections. In 1893 he named a new Miocene mammal *Ammodon leidyanum*.

Turning now to more direct references, in his well known vice-presidential address before the American Association for the Advancement of Science at its Nashville meeting in 1877 on the "Introduction and Succession of Vertebrate Life in America," Marsh says: "For our present knowledge of the extinct mammals, birds and reptiles of North America, science is especially indebted to Leidy, whose careful, conscientious work has laid a secure foundation for our vertebrate paleontology." Again, in the presidential address before the same association two years later at the Saratoga meeting ("History and Methods of Paleontological Discovery") we read: "The foundation of our vertebrate paleontology was laid by Leidy, whose contributions have enriched nearly every department of the subject."

Yale's admiration and gratitude for the learning of Philadelphia goes back to the beginning of the last century, when Benjamin Silliman went to that university to get his training in natural history from Professor Adam Seybert. This feeling Marsh inherited, and for the scientific men of the Academy of Natural Science he had only praise, save for the "militant paleontologist" of whom Osborn also speaks.

CHARLES SCHUCHERT
YALE UNIVERSITY

I am very glad indeed that Professor Schuchert is calling attention to the two paragraphs in Professor Marsh's writings in which he paid tributes to Joseph Leidy. My address was delivered under very great pressure, from hurried notes and absolutely extemporaneously. The statement I made was to the best of my memory and belief, but I am glad to qualify it now in the manner indicated by Professor Schuchert. It remains true, however, that the remarkable discoveries by Leidy in the genealogy of the horses, of the camels, of the rhinoceroses, of many other vertebrate groups, received scant or no recognition from either Marsh or Cope.

I am obliged to differ also from Professor Schuchert in the matter of prior descriptions. It is literally true, as I stated in my address, that the prior descriptions of species, and in many cases of genera, by Leidy were passed over in silence by both of his great successors. I hope at some future time to pay a very full tribute to the work of Marsh, as I have previously done to the work of Leidy and Cope. On this occasion I shall try to summarize Marsh's achievements, which were certainly monumental and deserving of highest recognition.

HENRY FAIRFIELD OSBORN
AMERICAN MUSEUM
OF NATURAL HISTORY

THE AUDIBILITY OF SOUNDS

THE note on "The audibility of consonants" in SCIENCE, February 22, 1924, p. xiv, calls to mind some analogous experiments made by the writer in 1905–6, part of a doctor's dissertation. The nonsense vocables used consisted of three syllables, each syllable a consonant followed by a vowel. There were six subjects, the material affording in all 1,296 interpretations of each consonant and 4,104 of each vowel utilized. The misperceptions of the consonants worked with ranged from 34 per cent. to 3 per cent., the order from most to fewest mistakes being *w, v, h, m, th* as in *the, l, g, p, b, d, n, r, k, t, f, th* as in *thought*. In respect to the character of the sounds wrongly heard, the tendency was to change the place of articulation rather than the method, thus *p* would be heard as *k* rather than as *f*. There was also some tendency for a person who heard a sound well when it was spoken to hear it erroneously instead of some other sound, and there were individual differences in the sounds so affected.

The vowels experimented with were *a, e, i, o, u*, in their "continental" values. The misperceptions ranged from 15 per cent. in the case of *e* to 3 per cent. in the case of *a*, the order being *e, i, u, o, a*.

F. L. WELLS

IN SOUTH CAROLINA

CHICORA COLLEGE FOR WOMEN is situated at Columbia, the capital city of South Carolina. It is owned by eight Presbyteries of the Synod of South Carolina, "in connection with the Presbyterian Church in the United States," and is managed by a Board of Trustees representing these various Presbyteries. Its president is Rev. S. C. Byrd, M.A., D.D., who is also professor of Bible and philosophy.

Under date of March 14, 1924, President Byrd sent the following letter to the members of the faculty of the college:

Dear Sir:

It has been rumored for a year or more now that there are members of our faculty who hold views which are not in harmony with the fundamental doctrines of historic evangelical Christianity—such as the inspiration, infallibility and authority of the Bible as the Word of God, the direct creation of man, the deity, virgin birth, vicarious death and bodily resurrection of Christ. I have been incredulous of these reports and was disposed to deny them. Recently, however, I have been inclined to fear that there is some foundation for them, and hence this letter.

As you know, the college is owned and controlled by the Southern Presbyterian Church, and is conducted for the purpose of promoting the education and training of our students in the essential principles of Christian doctrine and life as held by the Southern Presbyterian Church and a liberal education in accord with these principles.

It is confidently expected, therefore, that no officer or teacher in the college will hold views, religious or otherwise, which are contrary to or inconsistent with any of the fundamental doctrines of the church. Should such views be held by you, this letter is a request that I as the president of the college be informed of the fact. Should I not hear from you immediately in answer to this letter, I will understand that you hold no such views, and that these reports are without foundation so far as you are concerned.

Yours very cordially,

S. C. BYRD, President

Two professors in the college, Professor Guy A. Lackey, head of the department of education, and professor of education and philosophy, and Professor James M. Reinhardt, of the department of history and sociology, returned answers to the letter of a character presumably unsatisfactory to the president. Their resignations have been asked for, received and accepted.

These men were not questioned as to their creeds before they were employed. Professor Lackey—naïve soul—"took it for granted that all psychologists believe in evolution," and apparently, also, that presidents of all colleges, including denominational ones, realized this common failing of all psychologists.

VERNON KELLOGG

WASHINGTON, D. C.

QUOTATIONS

PROFESSOR WHITEHEAD

PROFESSOR A. N. WHITEHEAD, whose appointment for a period of five years to a chair of philosophy at Harvard was recently announced, is fortunate in securing at the age of sixty-three the opportunity it presents of writing up the philosophy that has gradually been developing and maturing in his mind. Free from much of the routine administration and committee work of a busy university life, with which he is so fully identified, he will be able, save for a few lectures or "chats" per week on his own researches with his students, to devote his whole time to the expansion and publication of his work in certain realms of thought which he had made peculiarly his own—the philosophy of science, mathematical logic and generally the philosophical questions arising from it. On the philosophical side, he proposes to extend and systematize his recent work as embodied in his "Principles of Natural Knowledge," his "Concept of Nature," and "Principles of Relativity," and to consider the metaphysical questions suggested. On the logical side, he intends finishing the fourth volume of "Principia Mathematica," dealing with geometry and more generally with many termed relations. On account of his versatility and his manifold activities, Professor Whitehead's departure from Great Britain will be felt as a great loss to many sections of the educational world, administrative and pedagogic. To the mathematical layman, he is perhaps best known for his "Introduction to Mathematics," probably his one successful book financially, and his collection of addresses, "The Organization of Thought." Since his early days, Professor Whitehead has been identified with a distinctively progressive attitude both with regard to the general philosophic basis of education and to the special technical facilities that demand development. On this account his loss to the Imperial College of Science and Technology, South Kensington, where he succeeded Professor A. R. Forsyth as chief professor of mathematics and mechanics, and to the University of London, where he is chairman of the academic council, can not be estimated. It is a severe commentary on the inelasticity of the British university educational system that it should be necessary for one of such eminence, charm of manner, and inspiring intercourse, to seek a period of five years in an educational establishment of another country in order at the close of an active career to find the opportunity of completing his research. Scientific thought undoubtedly stands to gain by this latest form of American enterprise.—*Nature.*

SCIENTIFIC BOOKS

Manual of the Vertebrates of the United States. By H. S. PRATT. P. Blakiston's Son and Company, Philadelphia.

NATURALISTS all over the country will have cause to rejoice at the convenient "Manual of the Vertebrates of the United States" recently brought out by Blakiston. It is written by Dr. H. S. Pratt, of Haverford College, and will serve an equally important function

as the "Manual of the Common Invertebrate Animals" by the same author (McClurg).

Like this latter book, which leaves out of account the insects, on the ground that they are practically a subdivision in themselves, and have been so often and so repeatedly written up that they may here be well left out of account, so in this new manual of the vertebrates the birds are similarly treated, and for the same reasons. The fishes, too, are limited to those of fresh-waters, that is, ponds, lakes and rivers, leaving out of account the ocean-dwellers. In the same way, no mention is made of the true oceanic mammals, whales and porpoises (Cetacea), although seals and manatees (Pinnipedia and Sirenia) are included, as are, of course, otters and beavers. The polar bear is shut out, on the other hand, not because of his occurrence frequently in salt water, but because of his non-inclusion geographically within the limits of the United States.

Within this territory, and within the limits of the animals treated, the author gives a detailed, and very modern, treatment, including not only the various species into which certain well-established and classical animals have expanded, but also in many cases has found room to enumerate many sub-species or varieties. For example, the fishes commonly called "trout" expand into five species of *Onchorhynchus,* 31 species of *Salmo,* two species of *Cristivomer,* and one species of *Salvilinus,* this last divided into five sub-species. Of course these are not all called "trout," for there are several "salmons" among them, which seem to be nothing but convenient popular distinctions, whose replacement by a more technical classification is much to be desired. The genus *Notropis* (Shiners) contains no less than 64 separate species, for which, although some distinctions may have been observed among careful and enthusiastic fishermen, there are nowhere near enough popular names in use among them. The catfish (Siluridae) are represented by five genera and 23 species, of which the commonest, *Ameiurus nebulosus,* is further divided into five subspecies.

The salamanders, so numerous a group in this country, are well expanded, represented by 21 genera and 63 species, the most plentiful North American family, the *Plethodontidae,* consisting of 14 of these genera and 39 of these species. Certain of the most abundant species, like *Desmogmathus fusca,* and *Eurycea* (*Spelerpes*) *bislineata,* mention seven subspecies, five of the first and two of the second, yet the end is not yet!

Scattered throughout the book there will be noticed certain new and unfamiliar names, such as *Eurycea* for the more familiar *Spelerpes*; *Triturus* for *Diemyctylus,* and the introduction of *Sylvilagus* for a branch of the old genus *Lepus.* These, however, follow closely the most recent revisions of the systematists, and are not only inevitable, but, as the systematists assure us, follow the established law of priority and will not be changed again. Opinions differ concerning the use of these revised names, especially between the systematists and the anatomists, and differences of opinion are natural among such men, since one of them focuses his attention upon the relations of the mesonephros, and those of the arterial arches, and the other upon the number of costal grooves and whether the fore-legs, when folded, reach the nose or not. Whatever opinion we may have on the matter, it is right and important that in writing a work upon systematic zoology the author adopt the newest uses of the systematists.

It is to be devoutly hoped that, eventually, these two groups will unite and no longer force us to employ a long synonymy for each animal; it is also not beyond the possibility that at least amateur fishermen, men who have a real love for nature and are actually naturalists, although they may be unwilling to acknowledge it, may learn to use the terms of systematic zoologists, and be no longer content with the use of vernacular names, which change locally and confuse well-marked varieties.

To accomplish these greatly desired ends, such works as these two of H. S. Pratt are especially calculated.

H. H. W.

A Manual of Laboratory Astronomy. By HARLAN TRUE STETSON, with the collaboration of JOHN CHARLES DUNCAN. Eastern Science Supply Co., Boston, 1923. 150 pages.

IN the teaching of descriptive astronomy, laboratory work has not, in general, been accorded the same relative amount of attention as it has received in physics and chemistry; and this neglect has in some cases been due not to the disinclination of the instructor to use the laboratory method, but to the want of suitable apparatus for indoor work or to the failure to realize that laboratory work need not be entirely dependent on the weather. This manual is well adapted to obviating such difficulties; for the authors have not only provided sufficient exercises for indoor use during cloudy weather, but have also made arrangements whereby the necessary equipment may be purchased conveniently from a single dealer.

The book in its present form contains 33 exercises designed to cover the material usually presented in an elementary course in descriptive astronomy, with references to Moulton's "Introduction to Astronomy," to Young's "Manual of Astronomy," and occasionally to Willson's "Laboratory Astronomy." The exercises are contained, however, in a demountable binding, which, for all practical purposes, holds the leaves as firmly as would a permanent binding, but which per-

mits the addition of new material or the rearrangement of the exercises to conform to any desired order of presentation.

Although trigonometry is not used, which may be regretted by some teachers, the exercises are not too elementary. The questions which accompany each exercise are especially well chosen and demand considerable thought on the part of the student. The explanations and instructions to students are admirable for their clearness and completeness, and should reduce personal supervision to a minimum.

CARL L. STEARNS

YALE OBSERVATORY

SPECIAL ARTICLES

ON THE DIFFICULTIES ENCOUNTERED IN THE EVOLUTION OF AIR-BREATHING VERTEBRATES

GEOLOGISTS and paleontologists have noticed and commented upon the relatively late origin of the air-breathing forms of animals, meaning thereby, as I understand the situation, the animals which can range freely at a considerable distance from the water. Some have attributed this late origin to the presence of high concentrations of carbon dioxide in the early atmosphere, so high, in hypothesis, as to preclude respiration in the atmosphere. When one compares the relative solubilities of carbon dioxide and oxygen in water at ordinary temperatures, it is a bit difficult to see how aquatic or marine forms would be very much better off as regards the presence of oxygen or the absence of carbon dioxide than the terrestrial forms. Chamberlin,[1] dissents from the view that high concentrations of carbon dioxide in the atmosphere prevented or delayed the appearance of land forms, and regards their late origin as due to the difficulties encountered in their evolution. I am inclined to agree with Chamberlin, as the difficulties to be overcome by these forms seem considerably greater than has been realized by either comparative anatomists or paleontologists. Some months ago, I[2] presented a short summary of my views on the organization of the nervous mechanism for the control of respiratory movements. The full data on which these conclusions were based have not yet been published, and the survey of the phylogenetic development of the respiratory mechanism is not yet finished, but some further conclusions bearing on the origin of the air-breathing vertebrates seem fairly clear. In view of their paleontological as well as physiological interest, I wish to make a further brief statement at this time.

[1] Chamberlin, T. C., *Journal of Geology*, 1897, V, 653.

[2] Pike, F. H., and Coombs, Helen C., SCIENCE, 1922, LVI, 691–693.

It is apparent that the respiratory mechanism of vertebrates has undergone more profound and far-reaching changes in the transition from aquatic to air-breathing forms than any other functional mechanism of the organism unless we except the central nervous system itself. The development of lungs has received much attention from comparative anatomists and paleontologists, but the development of lungs has supplied only a part of the new mechanism which was necessary. The respiratory muscles of fish are mainly those of the mouth or the special branchial muscles of the neck. So far as inspiration goes, these same muscles, or their lineal descendants, in the mouth are still functional in the amphibia which possess lungs. No conflict between food swallowed and respiratory medium taken into the mouth —water containing air in solution—occurs in fishes. With the development of an offshoot of the esophagus as an air passage in the frog, a coordination of the swallowing and the respiratory movements becomes necessary to prevent the entrance of food into the trachea and the air passages generally. This need becomes greater rather than less in successively higher types of vertebrates. The coordination of these two acts (swallowing and respiratory movements) requires the development of a special nervous mechanism which, so far as I am aware, does not exist in fish. The muscles of the flank and abdomen of the frog have some expulsive or expiratory action, but no true inspiratory action. It is only when the reptiles are reached that we find the muscles of the body wall acquiring a true inspiratory function. The frog, depending upon the muscles of the floor of the mouth for forcing the air into the lungs, can not take air into the lungs while holding the mouth open. Its food is limited to such things as it can swallow without holding the mouth open too long. The serpents, because of their ability to draw air into the lungs through the action of the muscles of the body wall, may swallow animals of considerable size, taking their leisure for the process and pausing to breathe when necessary. Though many of the reptiles still remain near the water, or even live in it most of the time, it is among these forms that we find the first animals which can live far from the water for relatively long periods. Lastly, we find in the mammals the final stages of the development of the new mechanism for maintaining a biologically adequate relation of the animal to the atmosphere. The diaphragm makes its appearance here, and I am one of those who dissent from the view that the diaphragm is of relatively little importance in respiration. All mammals may continue to take food or hold prey with the teeth without being compelled to stop occasionally to swallow air.

The change from the respiratory mechanism of

fishes to that of the first air-breathing animals which can range far from the water for long periods of time, and to the further stages attained in mammals has involved far more than the mere development of lungs. A new motor mechanism, with a highly organized and extremely efficient mechanism of nervous control, has been quite as necessary as the lungs themselves. The muscular changes have been considerable, but the changes in the nervous system have been quite as profound as those in the motor mechanism. But this nervous mechanism, in common with other highly organized machinery, has little possibility of new attainments (Hughlings Jackson) or of learning very much. Truly, the difficulties encountered in the transition from an aquatic to a terrestrial habitat have been great, and the first group to leave the water—the amphibians—has not wholly succeeded in overcoming them.[3]

The new mechanism, as far as I can see at present, first begins to assume a settled and definite form in reptiles. It is my present view, although the experimental evidence is not yet complete, that the respiratory connections with the midbrain, while partly established in amphibians, are first adequately established in reptiles. This seems only one more fact pointing to the importance of the reptilian group for the comparative physiologist who wishes to approach the study of the problems of organic evolution from the point of view of experimental physiology.

F. H. PIKE

COLUMBIA UNIVERSITY

A NEW FORMULA FOR THE ELECTRICAL RESISTANCE OF CERTAIN INHOMOGENEOUS SYSTEMS

IN the February number of the *Journal of Infectious Diseases* there is a paper by Dr. R. G. Green and myself dealing with the electrical conductance of systems of the following type: a suspension of yeast cells in a salt solution. In that paper we gave an approximate expression for the resistance of the suspension in terms of the volume occupied by the suspended particles and the specific resistances of the menstruum and of the suspended materials. I have recently arrived at a relation which I believe to be much more accurate.

Let c be the constant of the cell in which the resistances are measured; s, the specific resistance of the suspended material; a, the fraction of the total volume occupied by the suspended cells (assumed to be spherical); R, the resistance of the suspension; and M, the resistance when the salt solution alone fills the apparatus. Let $S = cs$.

Then the new equation is

$$R = M\left(\frac{1 + a\left(\frac{S-M}{2S+M}\right)}{1 - 2a\left(\frac{S-M}{2S+M}\right)}\right) \text{ or}$$

$$a = \frac{(R-M)(2S+M)}{(2R+M)(S-M)}$$

For the case in which the suspended particles have an infinite resistivity,

$$R = M\left(\frac{1+\frac{a}{2}}{1-a}\right) \quad \text{and} \quad a = \frac{2(R-M)}{2R+M}$$

Dr. Green and I will submit for publication in the near future a paper in which we shall undertake to prove the correctness of the formulae given above, and in which we shall apply them to experimental data old and new.

F. H. MACDOUGALL

SCHOOL OF CHEMISTRY,
UNIVERSITY OF MINNESOTA

[3] I am indebted to Dr. G. K. Noble for much information on the various adaptations and shifts which these forms have tried in the first attempt at terrestrial life. I would appreciate data bearing on peculiar means of respiration in other forms.

THE AMERICAN PHILOSOPHICAL SOCIETY

THE American Philosophical Society held its annual meeting in Philadelphia on April 24, 25 and 26, with the following program:

THURSDAY, APRIL 25

The fate of the soul of the elect in Manichaeism: A. V. WILLIAMS JACKSON, professor of Indo-Iranian Languages, Columbia University.

The Bornholm dialect of Danish: JOHN DYNELEY PRINCE, envoy extraordinary and minister plenipotentiary to Denmark.

Balder and the Golden Age: HERMANN COLLITZ, professor of Germanic philology, Johns Hopkins University.

Some effects of baths on man: H. C. BAZETT, B.Ch. (Oxon.), professor of physiology, University of Pennsylvania.

Differential permeability and cell reaction: M. H. JACOBS, Ph.D., professor of general physiology, University of Pennsylvania.

Pneumonia in Pittsburgh: EWALD TOMANEK, M.D., and EDWIN B. WILSON, Harvard School of Public Health.

The amending provision of the Federal Constitution in practice: HERMAN V. AMES, professor of history, University of Pennsylvania.

On the authorship of the anonymous pamphlet published in London, in 1760, entitled "The interest of Great Britain considered with regard to her colonies": I. MINIS HAYS, of Philadelphia.

The nation's transportation problem: EMORY R. JOHNSON, professor of transportation, University of Pennsylvania.

Obstacles to international commerce: LEWIS M. HAUPT, of Philadelphia.

The scientist and an international language: ROLAND G. KENT, professor of comparative philology, University of Pennsylvania.

THURSDAY, APRIL 26

Morning Session

Inheritance by tetrad sibs in Sphaerocarpos: CHARLES E. ALLEN, professor of botany, Columbia University.

The behavior of Oenothera neo-Lamarckiana in selfed line through six generations: BRADLEY M. DAVIS, professor of botany, University of Michigan.

Types and variants in certain coenobic plants: ROBERT A. HARPER, M.A., Ph.D., professor of botany, Columbia University.

A second independently inherited factor in the evening primroses (Oenothera): GEORGE H. SHULL, professor of botany and genetics, Princeton University.

Arrangement and action of material in the plasmatic layers and cell walls of plants: D. T. MACDOUGAL, director of the department of botanical research, Desert Botanical Laboratory, Carnegie Institution.

The curve of population growth: RAYMOND PEARL, professor of biometry and vital statistics, School of Hygiene and Public Health, Johns Hopkins University.

Faunal life zones of Mongolia—Jurassic to Upper Pliocene: HENRY F. OSBORN, research professor of zoology, Columbia University, and president of the American Museum of Natural History.

Fauna of the Santa Cruz beds of Patagonia: WILLIAM B. SCOTT, professor of geology, Princeton University.

Fauna of the concretionary zone of the Oreodon beds of the White River Oligocene: W. J. SINCLAIR, assistant professor of geology, Princeton University.

Afternoon Session

Presentation of a Tablet in Memory of HENRY LABARRE JAYNE, ESQ., late treasurer of the society.

SYMPOSIUM

Are the various races of man potentially equal? FRANZ BOAS, professor of anthropology, Columbia University; GEORGE GRANT MACCURDY, assistant professor prehistoric archeology and curator of anthropological section, Peabody Museum, Yale University; H. U. HALL, curator general ethnology, University Museum, University of Pennsylvania; ALEXANDER GOLDENWEISER, professor of anthropology, New School for Social Research, New York City.

SATURDAY, APRIL 26

Morning Session

The effect of temperature on the rate of embryonic development of certain orthoptera: J. H. BODINE, A.B., Ph.D., instructor in zoology, University of Pennsylvania. (Introduced by Dr. McClung.)

Symbiotic luminous bacteria as used by fishes: ULRIC DAHLGREN, professor of biology, Princeton University.

Transplantation of the spinal cord: SAMUEL R. DETWILER, Ph.D., assistant professor of zoology, Harvard University. (Introduced by Dr. Donaldson.)

The fishes used against yellow fever in Columbia: CARL H. EIGENMANN, professor of zoology, Indiana University.

The amount of carbon dioxide excreted by one centimeter of frog nerve fiber: GEORGE H. PARKER, director of the Museum of Comparative Zoology, Harvard University.

Sex in the right and left sides of the bird's body: OSCAR RIDDLE, research staff, Carnegie Station for Experimental Evolution, Cold Spring Harbor. (Introduced by Dr. Eigenmann.)

The prediction of the basal metabolism of girls: FRANCIS G. BENEDICT, director of the Nutrition Laboratory of the Carnegie Institution.

Some phases of the life of Gambetta: CHARLES DOWNER HAZEN, professor of history, Columbia University.

Vicarious Atonement: PAUL HAUPT, professor of Semitic languages, Johns Hopkins University.

Afternoon Session

The sonic depth finder: HARVEY C. HAYES, U. S. Naval Experiment Station, Annapolis. (Introduced by Mr. Bryant.)

Some new experiments in gravitation (Fourth Paper): CHARLES F. BRUSH, of Cleveland.

Further results concerning the earth's magnetic and electric fields: LOUIS A. BAUER, director of the Department of Terrestrial Magnetism, Carnegie Institution.

Abnormal under-voltage arcs in gases: C. B. BAZZONI, A.M., Ph.D., professor of experimental physics, and J. T. LAY, research associate, University of Pennsylvania. (Introduced by Professor Goodspeed.)

Application of positive ray analysis to problems of ionization: H. D. SMYTH, Ph.D., research fellow, Princeton University. (Introduced by Professor Karl T. Compton.)

Some properties of simple electric conducting net works: A. E. KENNELLY, A.M., Sc.D., professor of electrical engineering, Harvard University.

Wave lengths of iron lines in the vacuum Arc (By Title); *On the shift of the solar lines predicted by the theory of relativity:* KEIVIN BURNS, astronomer, Allegheny Observatory. (Introduced by Dr. H. D. Curtis.)

On the light deflections in the sun's gravitational field: ROBERT J. TRUMPLER, assistant astronomer at Lick Observatory. (Introduced by Dr. W. W. Campbell.)

Exploring the solar atmosphere: CHARLES E. ST. JOHN, Ph.D., astronomer, Mt. Wilson Observatory. (Introduced by Dr. John A. Miller.)

The present periodic table of the atoms: MONROE B. SNYDER, director emeritus of the Philadelphia Observatory.

On Friday evening there was a reception from 8 to 11 o'clock, at which Dr. Dayton C. Miller, professor of physics, Case School of Applied Science, Cleveland, spoke on "Visible sound" (experimentally illustrated).

The annual dinner was held on Saturday evening.